



Armed Forces College Of medicine AFCM



GOOD MORNING

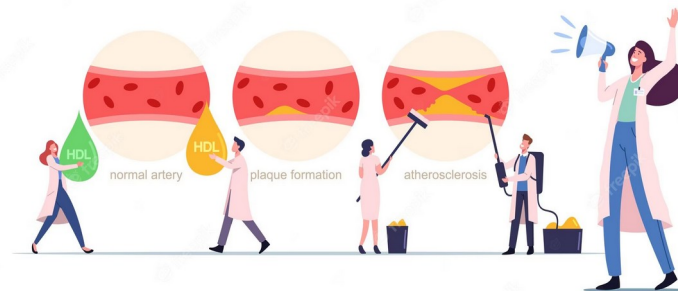
*may your day
be
as bright and
beautiful as
your smile!*





Pathology of Atherosclerosis

Prof. Eman Abdelbary



Intended Learning Objectives (ILOs)



By the end of this lecture the student will be able to:

1. Identify the aetiology types and complications of arteriosclerosis
2. Summarize the pathogenesis, features and effects of atherosclerosis
3. Correlate between causes, pathological features, laboratory findings and clinical effects of atherosclerosis.

Lecture Plan



1. Part 1 (10 min): Definition and types of arteriosclerosis
2. Part 2 (20 min): Definition, risk factors & pathogenesis of atherosclerosis
3. Part 3 (10 min): Pathological features & effects of atherosclerosis

Arteriosclerosis



Definition: Thickening & hardening of
arterial walls

Monckeberg's
sclerosis

Arteri**o**scle
ro
sis

Atherosclerosis
s

Atherosclerosis

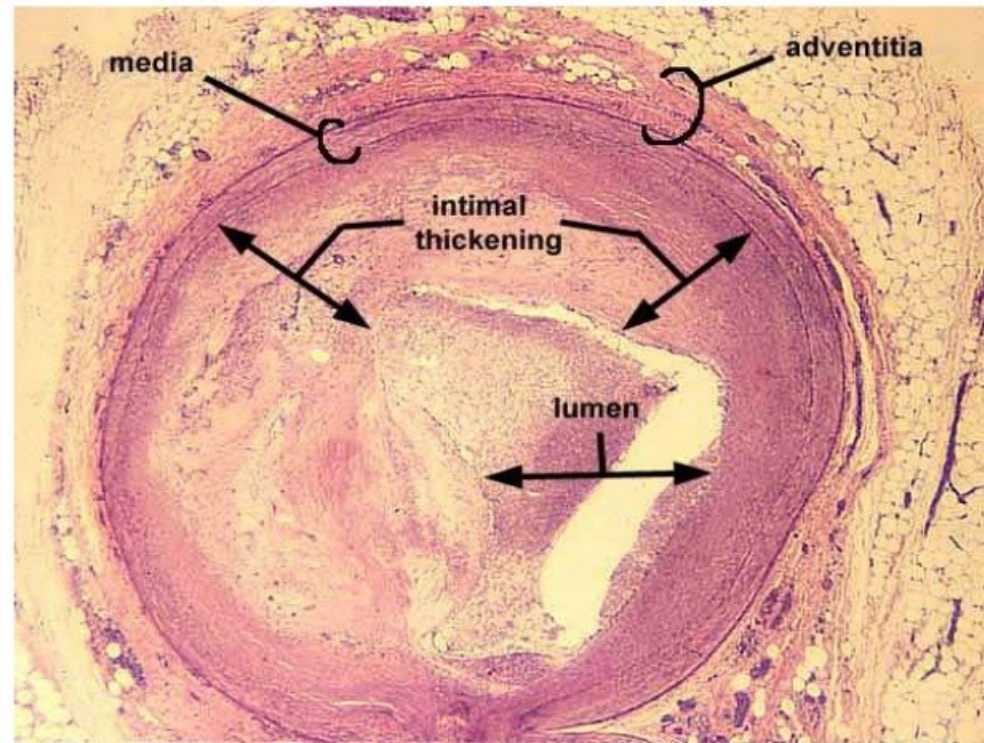


Definition: Patchy thickening of the intima of the arteries by lesions composed of deposited lipids surrounded by proliferating connective



Normal artery

<https://www.kumc.edu/instruction/medicine/anatomy/histoweb/vascular/small/Vasc06s.JPG>



http://1.bp.blogspot.com/-JUCsHnhIBJo/TkwBx2N9JwI/AAAAAAAAABSG/f1S_p35QveQ/w1200-h630-p-k-no-nu/atherosclerosis+%2528elastin+stain%2529.jpg
(Cardio-Pulmonary Module)

Atherosclerosis



Risk factors:

Major

NON-modifiable

Increasing age
Male gender
Family history
Genetic abnormalities

Modifiable

Hyperlipidemia
Hypertension
Cigarette smoking
Diabetes

Minor

Modifiable

Obesity
Physical inactivity
Stress ("type A" personality)
Postmenopausal estrogen deficiency
High carbohydrate intake

Alcohol
Lipoprotein Lp(a)
Hardened (trans)unsaturated fat intake
Chlamydia pneumoniae

Atherosclerosis



Major risk factors:

1- Dyslipidemia:

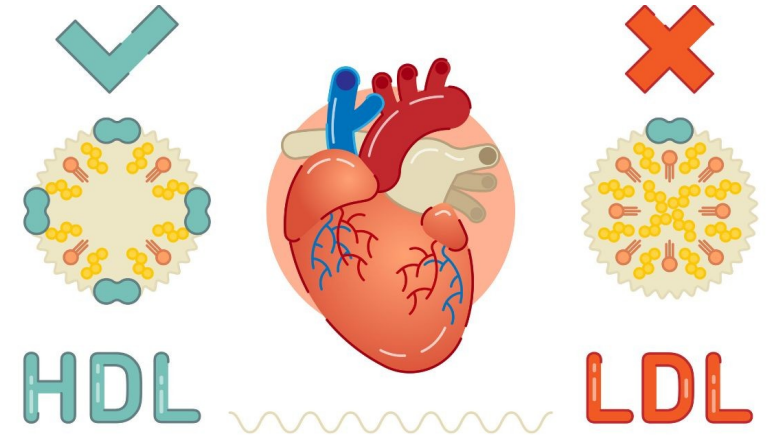
- **↑ level of low density lipoproteins (LDL)** strongly correlate with severity of atherosclerosis

- May be: Hereditary

Dietary (↑ intake of animal fat or trans fats)

Metabolic (diabetes)

- **↓ level of high density lipoproteins (HDL)**



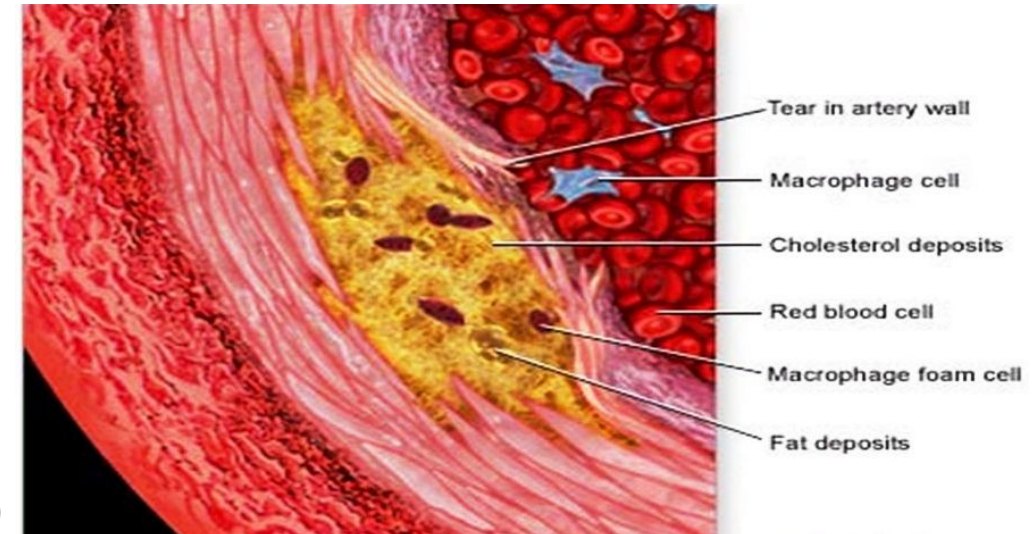
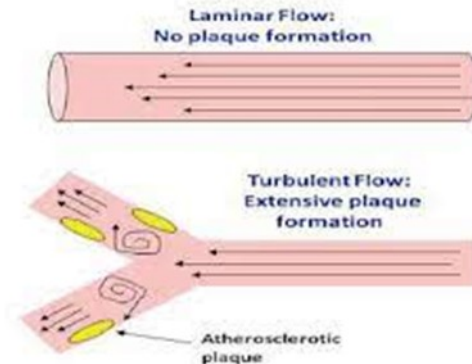
<https://i.pir>

Atherosclerosis



Major risk factors:

- 2- Vascular stress (Hypertension) → endothelial
- 3- Smoking: Cessation of smoking reduces the risk
- 4- Diabetes mellitus: Leads to hypercholesterolemia



Atherosclerosis



Major risk factors:

5- Age: Starts developing **during childhood**, clinical disease appears after **middle age**

6- Gender: **females are protected** by estrogen during child-bearing period. Atherosclerosis **develops after menopause**

7- Hereditary predisposition: e.g. hereditary hypercholesterolemia

8- Familial predisposition:

Atherosclerosis



Pathogenesis: Response to injury

hypothesis:

Hypertension, hyperlipidemia,

Chronic endothelial injury

**Trapping of LDL
in subendothelial**

CT \uparrow O₂ free radicals

\uparrow
**Oxidized LDL
(Insoluble)**

**Migration of
monocytes to the
intima**

**LDL uptake forming foam
cells**
 \uparrow cytokine release (TNF, IL 1)

Collagen synthesis

**Adherence of
platelets to the
intima**

**Release of growth factors
(PDGF)**

**Migration & proliferation of
smooth muscles from media**

Definition, risk factors & pathogenesis of atherosclerosis (Quiz)



Which of the following is a risk factor of atherosclerosis?

- A. Hypertension
- B. Low plasma level of LDL
- C. High plasma level of HDL
- D. Young age
- E. Female gender

Definition, risk factors & pathogenesis of atherosclerosis (Quiz)



Which of the following is a risk factor of atherosclerosis?

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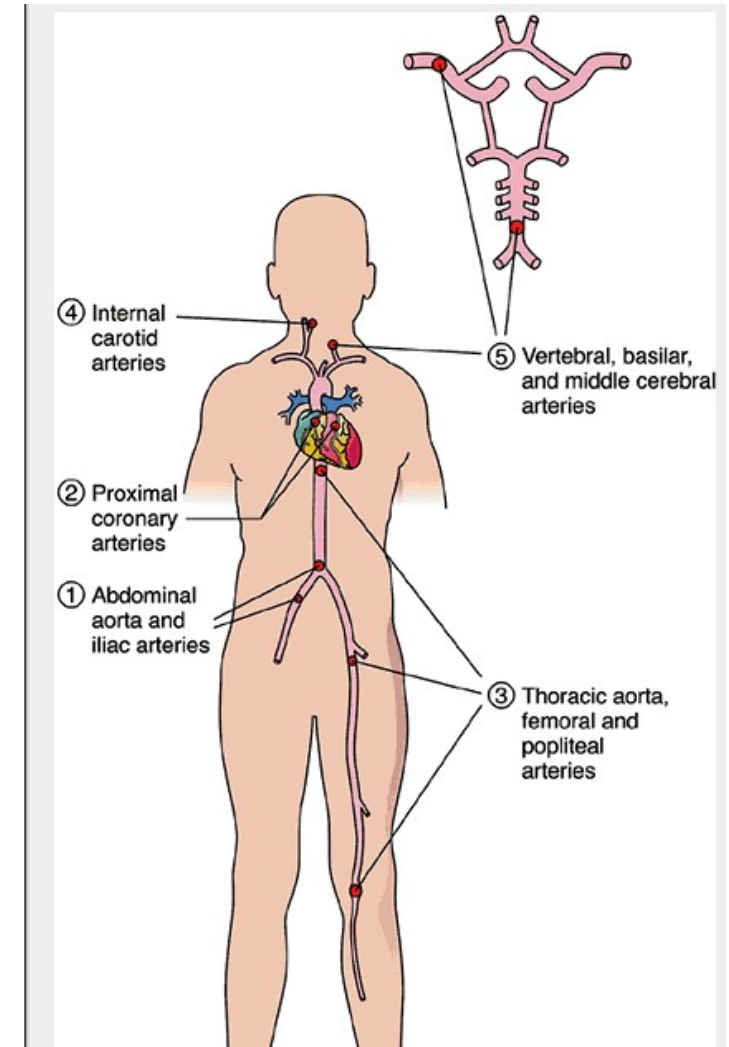
Atherosclerosis



Pathological

Distribution:

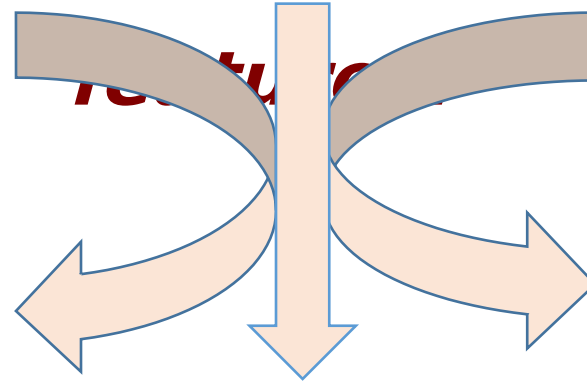
- **Large arteries:** aorta & its main branches
- **Small arteries:** coronaries & cerebral



Atherosclerosis



Pathological



**1. Fatty
streaks**

**2.
Atheromatou
s plaque**

**3.
Atheromatou
s ulcer**

Atherosclerosis

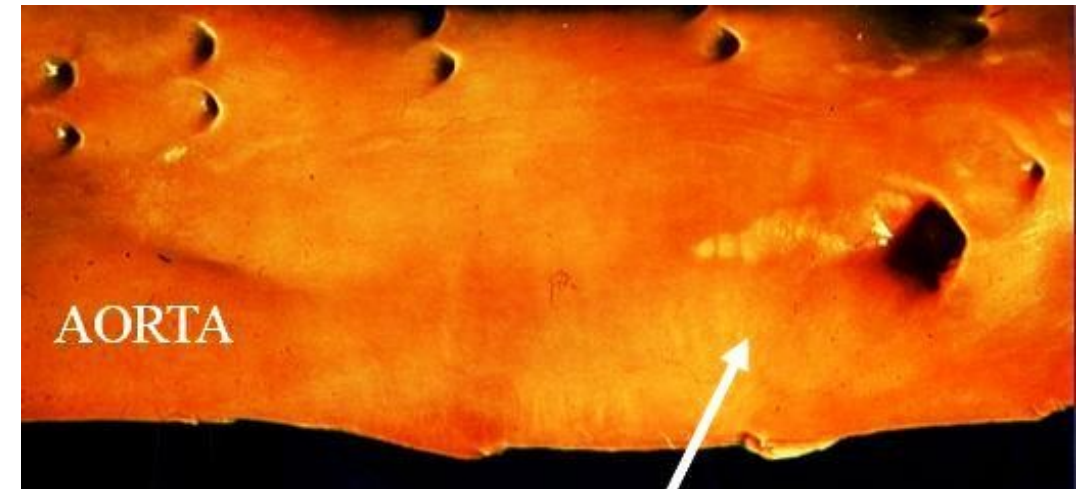


Pathological features: 1. Fatty streaks: (clinically reversible)

- ❖ Usually starts in childhood
- ❖ A precursor of atheromatous plaque
- ❖ Due to deposition of LDL in the subendothelial layer of the intima

❖ **Gross picture:**

soft, slightly raised, yellow streaks



https://s3.amazonaws.com/classconnection/572/flashcards/5349572/jpg/fatty_streak-14B468BDE373F1FDE81-thumb400.jpg

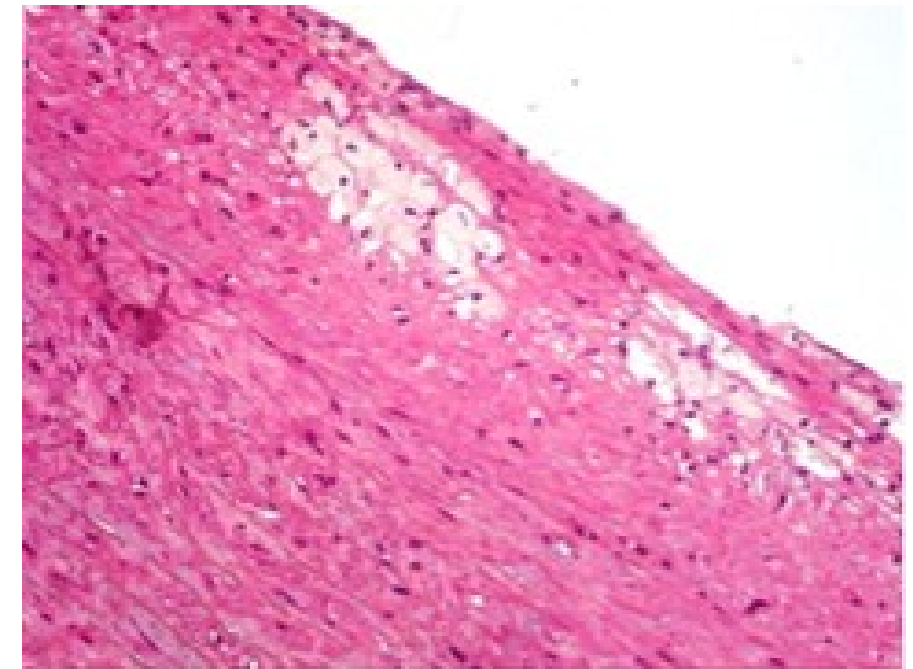
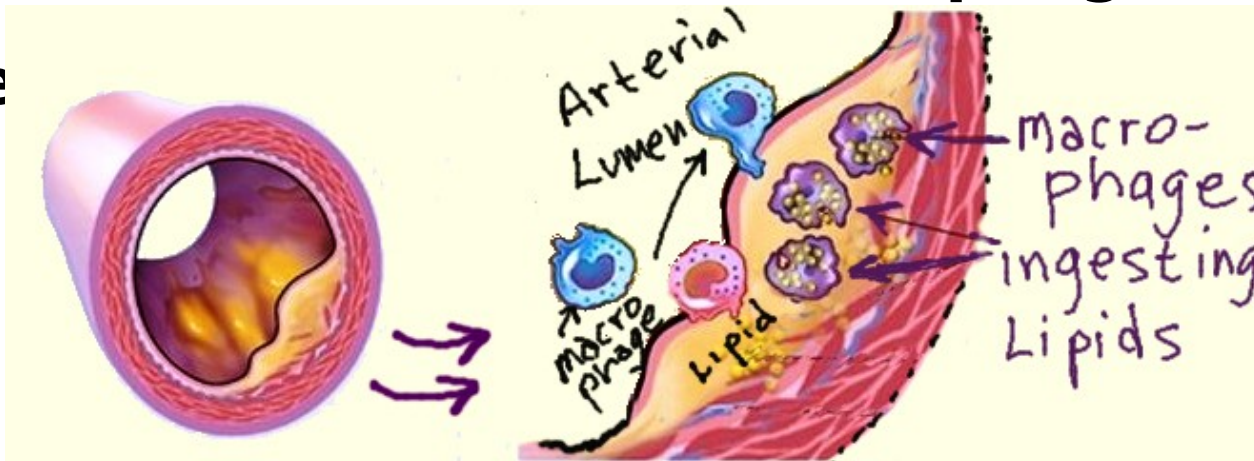
Atherosclerosis



Pathological features: 1. Fatty streaks:

❖ Microscopic picture:

Intimal subendothelial deposition
of: lipids (needle shaped **cholesterol
clefts**) + **foam cells** (macrophages



<https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcTx9ZC8VmpPrmtyB3ZTbix8CKtXc80G6k3loWqfApzrfY9kQsg7eg>

Atherosclerosis



Pathological features: 2. Atheromatous plaque

- ❖ **(*atheroma*):**
The main lesion
- ❖ Due to fibrosis around deposited lipids
- ❖ **Gross picture:**
 - Patchy, firm, raised, yellow white plaques
- ▢ May be hard due dystrophic calcification



<https://s3.amazonaws.com/cdn.guiaimedica.com/wp-content/uploads/2016/01/15150632/Colesterol-Sangre.jpg>



(Cardio-Pulmonary Module)

<https://d1yboe6750e2cu.cloudfront.net/i/9d5ead2817619080746d5a6e0d3bcb6aa06feb73>

Atherosclerosis

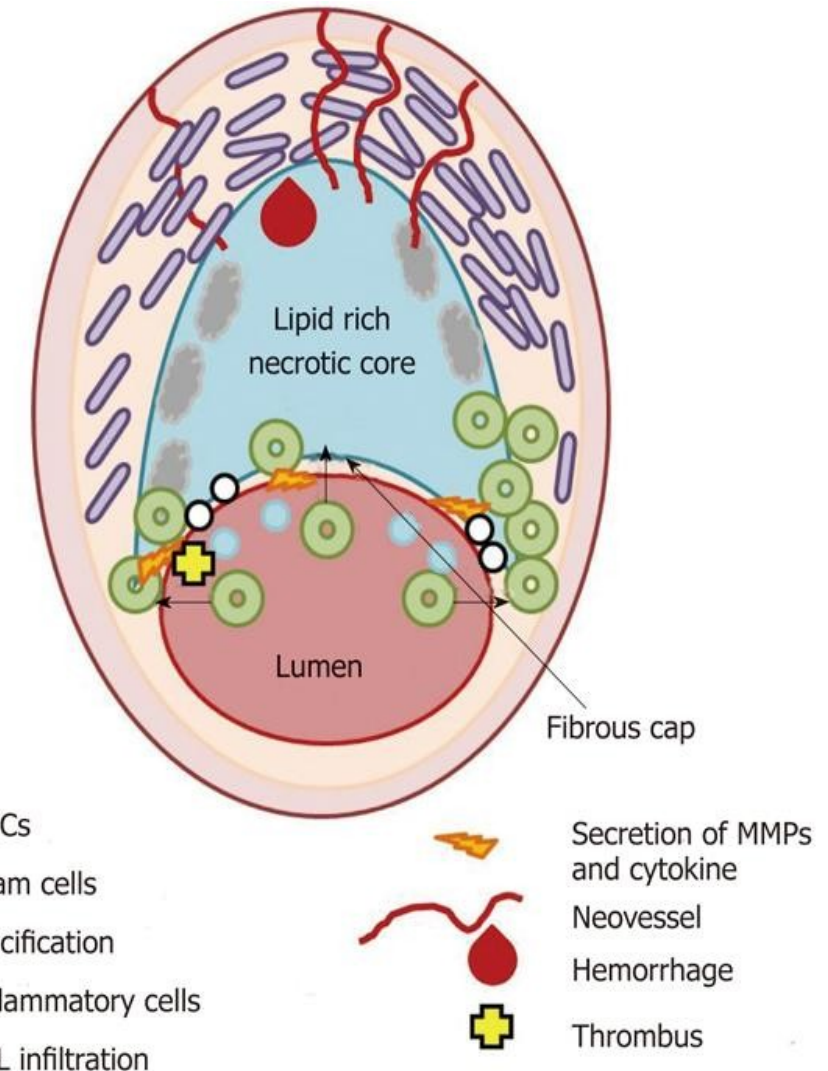


Pathological features: 2. Atheroma:

❖ Microscopic picture:

Intimal subendothelial deposition of:

- Needle shaped **cholesterol clefts + foam cells**
- Vascularization (**capillaries** from endothelium of the intima or vasa vasorum)
- **Smooth muscle proliferation + fibrosis**
- **Dystrophic calcification** (dark blue

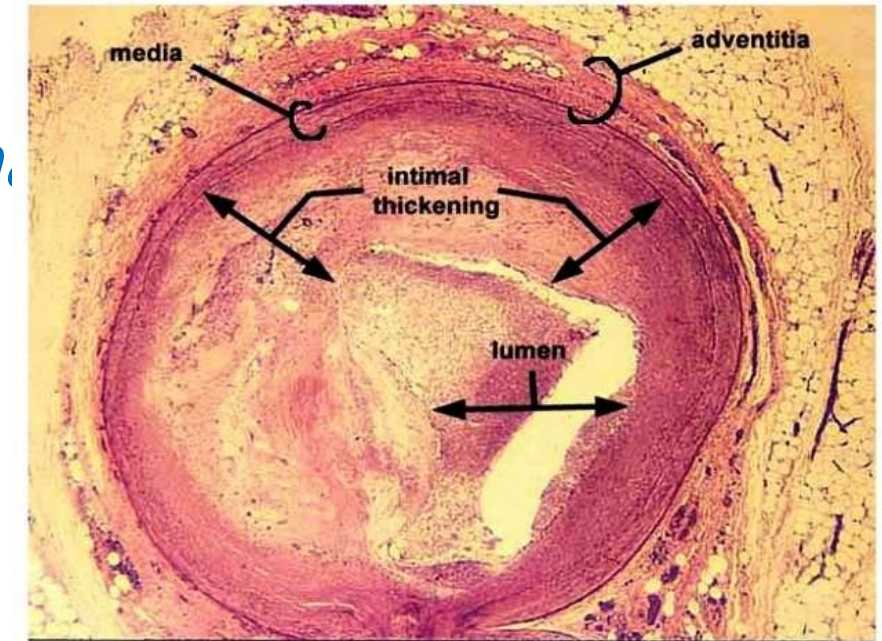
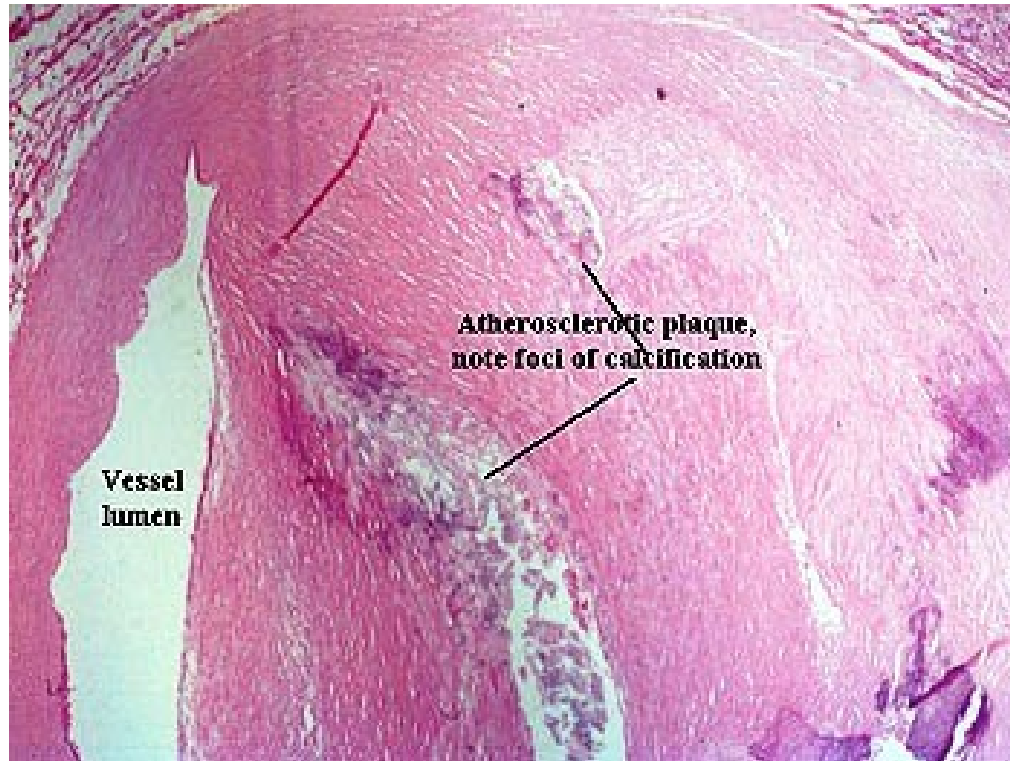


Atherosclerosis

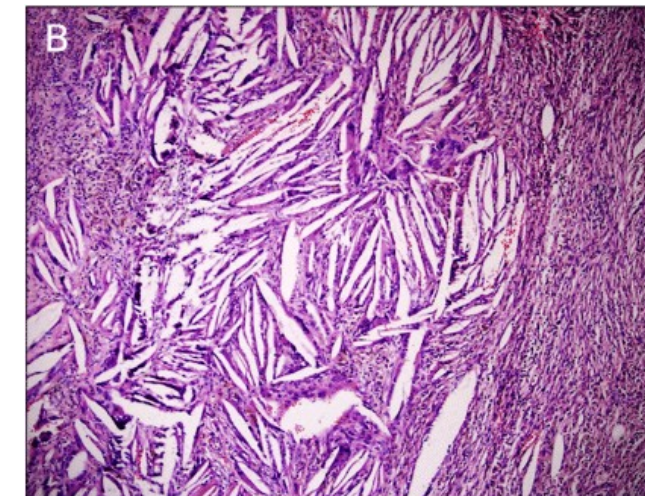


Pathological features: 2. Atheroma

❖ Microscopic picture:



http://1.bp.blogspot.com/-JUCsHnhIBJo/TkwBx2N9JwI/AAAAAAAAABSG/f1S_p35QveQ/w1200-h630-p-k-no-atherosclerosis+%2528elastin+stain%2529.jpg



Atherosclerosis



Pathological features: 3. Atheromatous

❖ **Gross picture:**

➤ **Irregular ulcers with sharp edges**

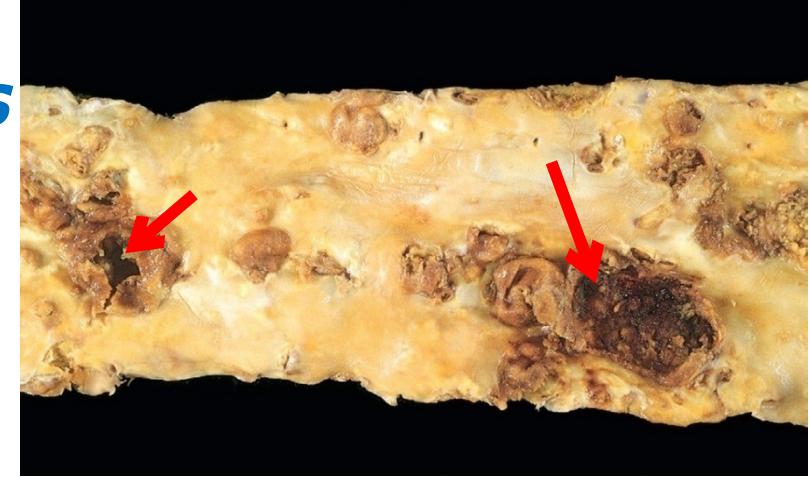
(due to necrosis of endothelial covering of atheroma).

➤ **May show dystrophic calcification & thrombosis**

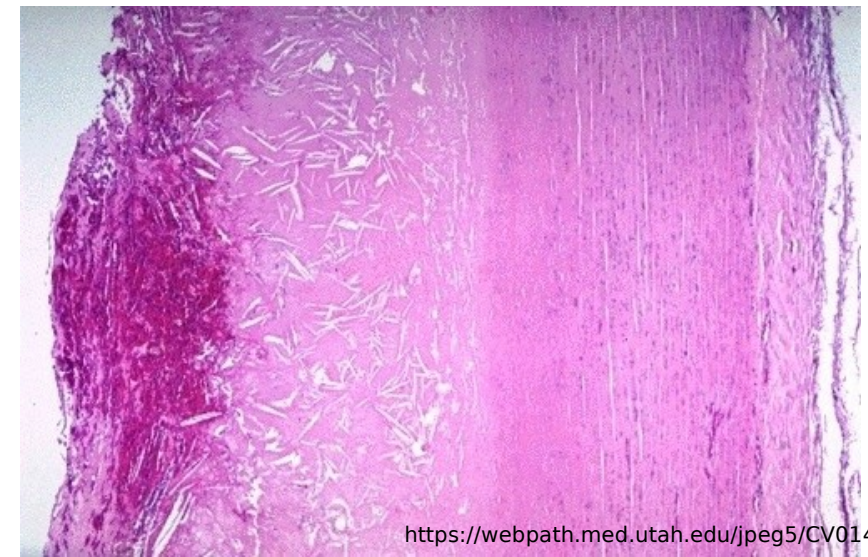
❖ **Microscopic picture:**

As atheroma + necrosis of overlying

endothelium + superimposed thrombosis



http://3.bp.blogspot.com/-dihl24j_nyo/TqrnVDFRjGI/AAAAAAAAAYk/OxRvjZXPozw/s1600/Severe+Artherosclerosis.png



<https://webpath.med.utah.edu/jpeg5/CV014.jpg>

Pathological features & effects of atherosclerosis (z)



Write True or False:

1. In atherosclerotic aorta, The media is thick and hypertrophied False
2. Fatty streaks are precursors of atherosclerosis than occur at middle age False

Atherosclerosis



Effects & complications:

1- Ischemia:

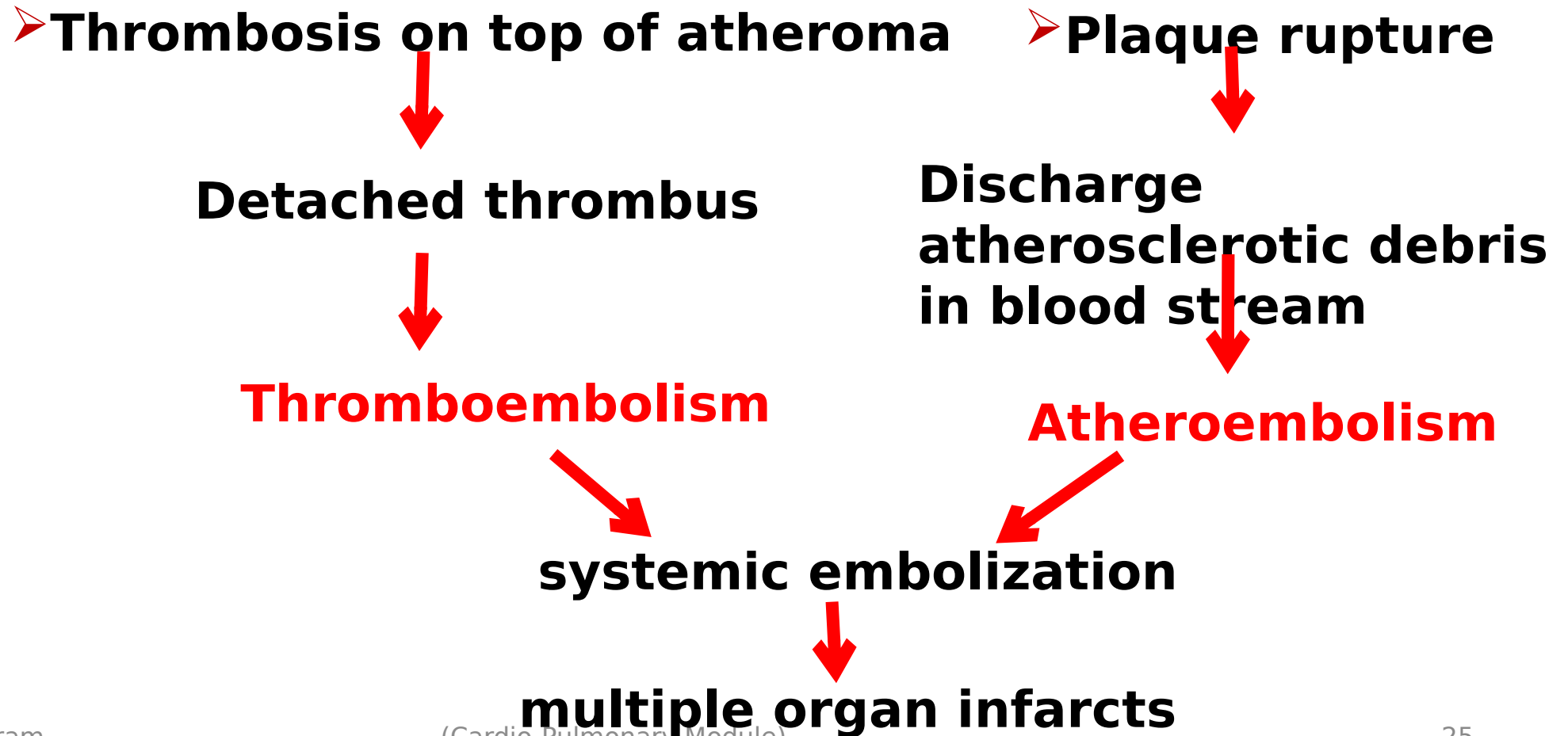
Complete occlusion	Incomplete occlusion	
<ul style="list-style-type: none">-Thrombosis on top of atheroma-Haemorrhage into the plaque increasing the size of atheroma	Atherosclerotic plaque	Etiology
Myocardial infarction	Arteriosclerotic heart disease (chronic cardiac ischemia)	:Effects Coronary - atherosclerosis
Dry gangrene <small>New Five Year Program</small>	Intermittent claudications	Femoral - atherosclerosis

Atherosclerosis



Effects & complications:

2. Embolism:



Atherosclerosis

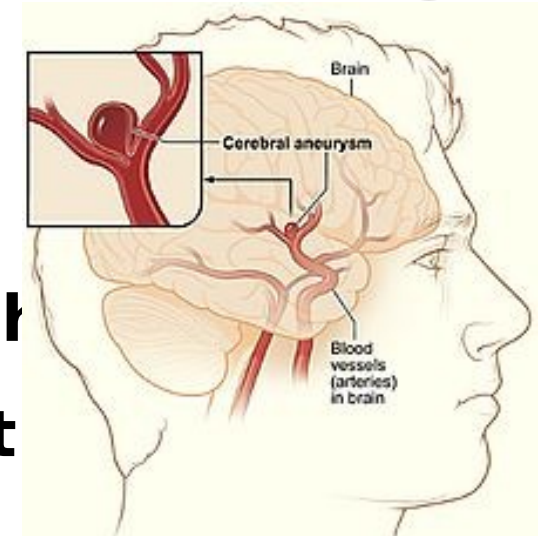


Effects & complications:

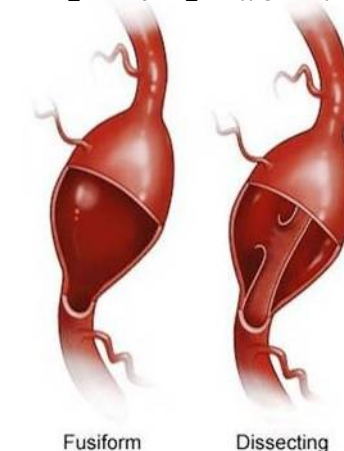
3- Aneurysm formation: Due to stretch of atrophied

Small arteries: Cerebral arteries are commonest

In aorta: Fusiform, or dissecting



https://upload.wikimedia.org/wikipedia/commons/thumb/8/80/Cerebral_aneurysm_NIH.jpg/220px-Cerebral_aneurysm_NIH.jpg



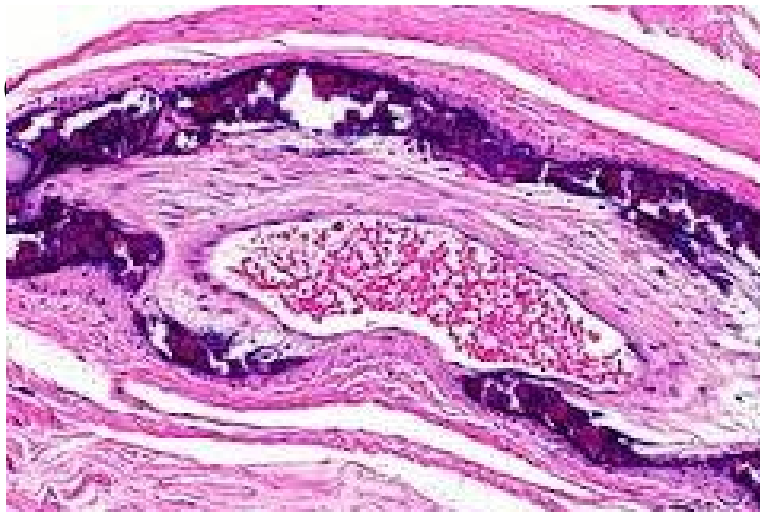
<http://s3.amazonaws.com/magoo/ABAAfPq0AI-3.jpg>

Monkberg's medial calcific sclerosis

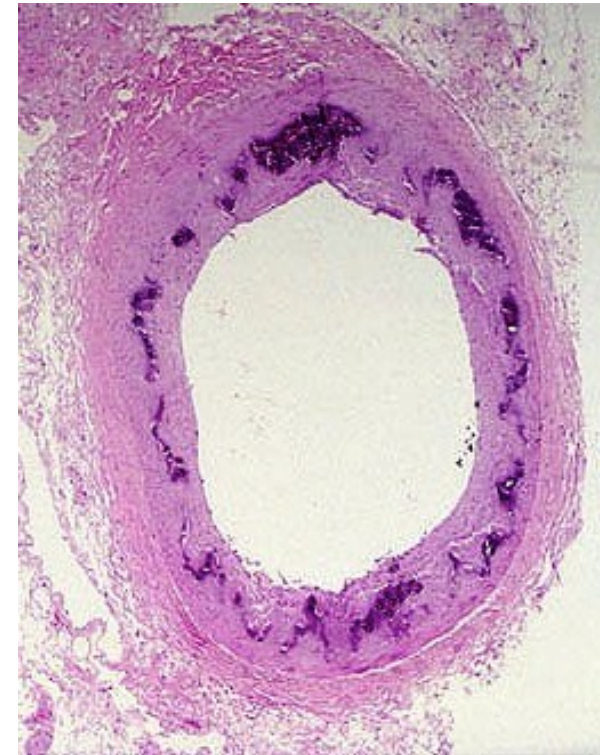


Definition: calcification of the media of medium sized arteries of elderly people e.g. femoral & radial arteries.

Lesions don't encroach on the vessel lumen → it is asymptomatic (detected)



https://librepathology.org/w/images/thumb/5/51/Medial_calcific_sclerosis_-_intermed_mag.jpg/300px-Medial_calcific_sclerosis_-_intermed_mag.jpg
(Cardio-Pulmonary Module)



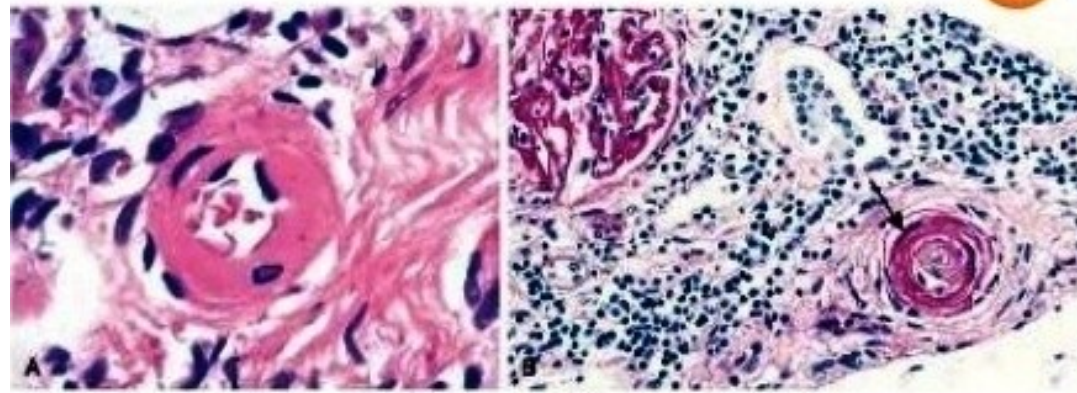
<https://webpath.med.utah.edu/jpeg5/CV168.jpg>

Arteriolosclerosis



Definition:

Thickening & narrowing of **arterioles and small arteries, occurring in cases of hypertension & D.M.**



hyaline arteriolosclerosis

hyperplastic arteriolosclerosis

<https://slideplayer.com/slide/13484768/83/images/30/Hyaline+%28L%29+and+hyperplastic+%28R%29+arteriolosclerosis.jpg>

Pathological features & effects of atherosclerosis (z)



A 56-year-old male has not seen a physician for years. He reports reduced exercise tolerance over the past 5 years. On occasion in the past year he has noted chest pain after ascending stairs. He smokes 2 packs of cigarettes per day. His blood pressure is 155/95 mm Hg. His laboratory investigations revealed elevated serum cholesterol level. The following vascular abnormality is most likely to be his most serious health risk?

- A. Lymphedema
- B. Medial calcific sclerosis
- C. Atherosclerosis
- D. Deep venous thrombosis

Pathological features & effects of atherosclerosis (Cz)



A 56-year-old male has not seen a physician for years. He reports reduced exercise tolerance over the past 5 years. On occasion in the past year he has noted chest pain after ascending stairs. He smokes 2 packs of cigarettes per day. His blood pressure is 155/95 mm Hg. His laboratory investigations revealed elevated serum cholesterol level. The following vascular abnormality is most likely to be his most serious health risk?

- A. Lymphedema
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- C. Atherosclerosis**
- D. Deep venous thrombosis

Key points:



- Arteriosclerosis includes atherosclerosis, Monckberg's medial calcific sclerosis and arteriolosclerosis
- Major modifiable risk factors of atherosclerosis are hypertension, diabetes, cigarette smoking and hyperlipidaemia
- Atherosclerosis affects large and small sized arteries, less commonly affects medium sized arteries
- Pathological features of atherosclerosis are fatty streaks, plaque and ulcer
- The major effects of atherosclerosis are ischemia and aneurysm formation

Suggested textbooks



1. Mitchell R. Blood vessels. In Robbins and Cotran pathologic basis of disease, 9th edition. Kumar, Abbas & Aster (eds). Elsevier Saunders. Pages 491 to 501.
2. USMLE step 1 lecture notes, 2017. Kaplan INC, New York. Pages 103

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THANK YOU!